9th Class 2021

Math (Science)	Group-II	Paper-I
Time: 2.10 Hours	(Subjective Type)	Max. Marks: 60

(Part-I)

2. Write short answers to any Six (6) questions: (12)

(i) Find the multiplicative inverse:

$$A = \begin{bmatrix} -1 & 3 \\ 2 & 0 \end{bmatrix}$$

Ans

$$A = \begin{bmatrix} -1 & 3 \\ 2 & 0 \end{bmatrix}$$

$$|A| = \begin{vmatrix} -1 & 3 \\ 2 & 0 \end{vmatrix}$$

$$|A| = (0 \times -1) - (2 \times 3)$$

$$= 0 - 6$$

$$= -6 \neq 0$$

Inverse is possible.

$$\text{Adj } A = \begin{bmatrix} 0 & -3 \\ -2 & -1 \end{bmatrix}$$

$$A^{-1} = \frac{\text{Adj } A}{|A|}$$

$$A^{-1} = \frac{\begin{bmatrix} 0 & -3 \\ -2 & -1 \end{bmatrix}}{-6}$$

$$A^{-1} = \frac{-1}{6}\begin{bmatrix} 0 & -3 \\ -2 & -1 \end{bmatrix}$$

$$= \begin{bmatrix} \frac{0}{-6} & \frac{-3}{-6} \\ \frac{-2}{-6} & \frac{-1}{-6} \end{bmatrix}$$

$$A^{-1} = \begin{bmatrix} 0 & +\frac{1}{2} \\ +\frac{1}{3} & +\frac{1}{6} \end{bmatrix}$$

$$A^{-1} = \begin{bmatrix} 0 & \frac{1}{2} \\ \frac{1}{3} & \frac{1}{6} \end{bmatrix}$$

(ii) Simplify: $5^{2^3} \div (5^2)^3$

Ans

$= 5^{2^3} \div (5^2)^3$

$= 5^8 \div 5^6$

$= 5^{8-6}$

$= 5^2$

$\boxed{= 25}$

(iii) Simplify: $\sqrt[5]{\dfrac{3}{32}}$

Ans

$$\sqrt[5]{\frac{3}{32}} = \frac{\sqrt[5]{3}}{\sqrt[5]{32}}$$

$$= \frac{(3)^{1/5}}{(32)^{1/5}} = \frac{3^{1/5}}{2^{5 \times 1/5}}$$

$$= \frac{3^{1/5}}{2}$$

(iv) Write the conjugate: $-i$

Ans Let $z = -i$

$\overline{z} = \overline{0 - i} = 0 + i$

$\overline{z} = i$

(v) Express in ordinary form: 5.06×10^{10}

Ans

$\dfrac{5.06}{100} \times 10^{10}$

$506 \times \dfrac{10^{10}}{10^2}$

506×10^8

$= 506 \times 100000000$

$= 50600000000$

(vi) Find the value of x: $\log_x 64 = 2$

Ans $\log_x 64 = 2$

Write in exponent form.

$$(x)^2 = 64$$
$$(x)^2 = (8)^2$$

Taking square root,

$$(x^2)^{1/2} = (8^2)^{1/2}$$
$$x = 8$$

(vii) Reduce to lowest form: $\dfrac{x^2 - 4x + 4}{2x^2 - 8}$

Ans

$$\frac{x^2 - 4x + 4}{2x^2 - 8} = \frac{x^2 - 2x - 2x + 4}{2(x^2 - 4)}$$
$$= \frac{x(x-2) - 2(x-2)}{2(x^2 - 2^2)}$$
$$= \frac{(x-2)\cancel{(x-2)}}{2(x+2)\cancel{(x-2)}}$$
$$= \frac{x-2}{2(x+2)}$$

(viii) Simplify: $\sqrt{21} \times \sqrt{7} \times \sqrt{3}$

Ans $\sqrt{21} \times \sqrt{7} \times \sqrt{3} = \sqrt{21 \times 7 \times 3}$

$$= \sqrt{3 \times 7 \times 7 \times 3}$$
$$= \sqrt{3^2 \times 7^2}$$
$$= 3 \times 7$$
$$= 21$$

(ix) Factorize: $2xy^3(x^2 + 5) + 8xy^2(x^2 + 5)$

Ans

$$2xy^3(x^2 + 5) + 8xy^2(x^2 + 5)$$
$$= 2xy^2[y(x^2 + 5) + 4(x^2 + 5)]$$
$$= 2xy^2[(x^2 + 5)(y + 4)]$$
$$= 2xy^2(x^2 + 5)(y + 4)$$

3. Write short answers to any Six (6) questions: (12)

(i) Use factorization to find the square root of:

$$4x^2 - 12xy + 9y^2$$

Ans $4x^2 - 12x + 9$

$$= (2x)^2 - 2(2x)(3) + (3)^2$$
$$= (2x - 3)^2$$

Square root $= \sqrt{(2x - 3)^2}$

$$= \pm(2x - 3)$$

(ii) Solve the equation: $\sqrt{3x+4} = 2$

Ans

$$\sqrt{3x+4} = 2$$

Squaring both sides,

$$(\sqrt{3x+4})^2 = (2)^2$$
$$3x + 4 = 4$$
$$3x = 4 - 4$$
$$3x = 0$$
$$\boxed{x = 0}$$

(iii) Solve for x: $\left|\dfrac{x+5}{2-x}\right| = 6$

Ans

$$\left|\frac{x+5}{2-x}\right| = 6$$
$$\pm\left(\frac{x+5}{2-x}\right) = 6$$

$$\frac{x+5}{2-x} = 6$$
$$x + 5 = 6(2 - x)$$
$$x + 5 = 12 - 6x$$
$$x + 6x = 12 - 5$$
$$7x = 7$$
$$x = \frac{7}{7}$$
$$\boxed{x = 1}$$

$$-\left(\frac{x+5}{2-x}\right) = 6$$
$$-(x + 5) = 6(2 - x)$$
$$-x - 5 = 12 - 6x$$
$$-x + 6x = 12 + 5$$
$$5x = 17$$
$$\Rightarrow \boxed{x = \frac{17}{5}}$$

So, solution set $= \left\{1, \dfrac{17}{5}\right\}$.

(iv) Find the values of m and c of the line $x - 2y = -2$ by expressing it in the form $y = mx + c$.

Ans

$$x - 2y = -2$$
$$-2y = -x - 2$$
$$\frac{-2y}{-2} = -\frac{x}{-2} - \frac{2}{-2}$$
$$y = \frac{1}{2}x + 1$$
$$y = mx + c$$

By comparison,

$\Rightarrow \quad m = \frac{1}{2}, c = 1.$

(v) Verify whether the point (5, 3) lies on the line $2x - y + 1 = 0$ or not.

Ans $2x - y + 1 = 0$

Putting $x = 5$ and $y = 3$ in given equation

$$2(5) - 3 + 1 = 0$$
$$10 - 3 + 1 = 0$$
$$7 + 1 = 0$$
$$8 \neq 0 \text{ (Which is not true)}$$

Hence, the point (5, 3) does not lie on line $2x - y + 1 = 0$.

(vi) Find the distance between pair of points A(7, 5), B(1, −1).

Ans A(7, 5), B(1, −1)

Here $x_1 = 7, y_2 = -1, \quad x_2 = 1, y_1 = 5$

The distance formula is:

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

$$|\overline{AB}| = \sqrt{(1 - 7)^2 + (-1 - 5)^2}$$
$$= \sqrt{(-6)^2 + (6)^2}$$
$$= \sqrt{36 + 36}$$
$$= \sqrt{72}$$
$$= \sqrt{36 \times 2}$$

$$|\overline{AB}| = 6\sqrt{2}$$

(vii) Find the mid-point between the pair of points: A(−5, −7), B(−7, −5)

Ans A(−5, −7), B(−7, −5)

Here $x_1 = -5, y_1 = -7$

$x_2 = -7, y_2 = -5$

Formula,

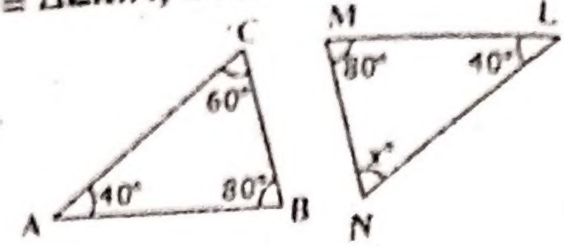
$$M(x, y) = \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$$

$$M(x, y) = \left(\frac{-5 - 7}{2}, \frac{-7 - 5}{2}\right)$$

$$= \left(\frac{-12}{2}, \frac{-12}{2}\right)$$

$$M(x, y) = (-6, -6)$$

(viii) If $\Delta ABC \cong \Delta LMN$, then find the unknown x:



Ans As $\Delta ABC \cong \Delta LMN$

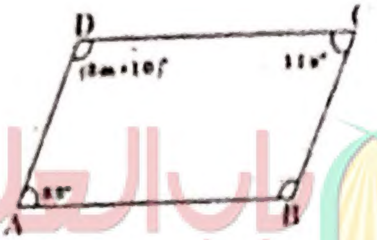
$m\angle A = m\angle L = 40^o$ and

$m\angle B = m\angle M = 80^o$ and

$m\angle N = m\angle C$

So, $x^o = 60^o$

(ix) The given figure ABCD is a parallelogram, find x and m:



Ans As $\angle C = \angle A$

$11x^o = 55^o$

$\Rightarrow \boxed{x^o = 5^o}$

$\angle C = 11x^o = 11(5^o) = 55^o$

Since $\angle B + \angle C = 180^o$

$\angle B + \angle 55^o = 180^o$

$\Rightarrow \angle B = 180^o - 55^o$

$\Rightarrow \angle B = 125^o$

Now $\angle B = \angle D$

$125^o = (5m + 10)$

$125 = 5m + 10$

$125 - 10 = 5m$

$115 = 5m$

$m = \frac{115}{5} = 23^o$

Write short answers to any Six (6) questions: (12)

(i) Define similar triangles.

Ans Two (or more) triangles are called similar (symbol ~) if they are equiangular and measures of their corresponding sides are proportional.

(ii) Define ratio.

Ans Comparison of two alike quantities having same units of quantities and same units is called ratio.

It is expressed as; a : b or $\frac{a}{b}$. For example, 2 : 3.

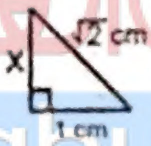
(iii) 3 cm, 4 cm and 7 cm are not the lengths of the triangle. Give the reason.

Ans The sum of the lengths of any two sides of a triangle is always greater than the length of third side.

Here the sides are: 3 cm, 4 cm and 7 cm. From this sum of the two sides 3 + 4 = 7, which is equal to third side.

Hence 3 cm, 4 cm and 7 cm cannot be the lengths of a triangle.

(iv) Find the unknown value in the given figure:



Ans In right angled ΔABC,

$(m\ AC)^2 = (m\ AB)^2 + (m\ BC)^2$ (Pythagoras theorem)

By putting values,

$$(\sqrt{2})^2 = (x)^2 + (1)^2$$
$$2 = x^2 + 1$$
$$x^2 = 2 - 1$$
$$x^2 = 1$$

By taking square root,

$$\sqrt{x^2} = \sqrt{1}$$
$$x = 1\text{ cm}$$

(v) Verify that the triangle having the measures of sides is a right triangle:

a = 16 cm, b = 30 cm, c = 34 cm

Ans $a = 16$ cm, $b = 30$ cm, $c = 34$ cm

By taking square of each value,

$$(a^2) = (16)^2 = 256$$
$$(b)^2 = (30)^2 = 900$$
$$(c)^2 = (34)^2 = 1156$$

As we know that

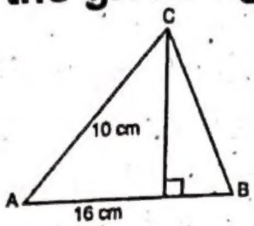
$$c^2 = a^2 + b^2 \quad \text{(Pythagoras theorem)}$$
$$1156 = 256 + 900$$
$$1156 = 1156$$

$\therefore$ The given values are the lengths of a right triangle.

(vi) Define rectangular region.

Ans A rectangular region is the union of a rectangle and its interior.

(vii) Find the area of the given figure:



Ans $\text{Area} = \frac{1}{2} \times \text{Base} \times \text{Height}$

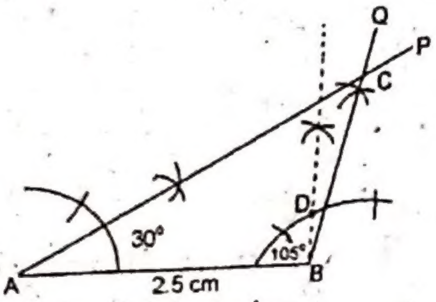
$$= \frac{1}{2} \times 16 \times 10$$
$$= 80\ \text{cm}^2$$

(viii) Define centroid.

Ans The point of concurrency of three medians of a triangle is called centroid of triangle.

(ix) Construct a ΔABC in which: $m\overline{AB} = 2.5$ cm, $m\angle A = 30^\circ$, $m\angle B = 105^\circ$

Ans



ABC is the required triangle.

(Part-II)

NOTE: Attempt THREE (3) questions in all. But question No. 9 is Compulsory.

Q.5.(a) Use matrices inverse method to solve the linear equations, if possible: (4)

$$2x - 2y = 4, \quad 3x + 2y = 6$$

Ans

$$2x - 2y = 4$$
$$3x + 2y = 6$$

Writing the equation in matrix form,

$$\begin{bmatrix} 2 & -2 \\ 3 & 2 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 4 \\ 6 \end{bmatrix}$$

Let $AX = B$

$$X = A^{-1} B$$

where $A = \begin{bmatrix} 2 & -2 \\ 3 & 2 \end{bmatrix}$, $X = \begin{bmatrix} x \\ y \end{bmatrix}$

and $B = \begin{bmatrix} 4 \\ 6 \end{bmatrix}$

Now, $A = \begin{bmatrix} 2 & -2 \\ +3 & 2 \end{bmatrix}$

$$|A| = \begin{vmatrix} 2 & -2 \\ +3 & 2 \end{vmatrix}$$
$$= 4 - (-6)$$
$$= 4 + 6$$
$$= 10 \neq 0$$

Solution is possible.

$$\text{Adj } A = \begin{bmatrix} 2 & 2 \\ -3 & 2 \end{bmatrix}$$

$$A^{-1} = \frac{\text{Adj } A}{|A|}$$

$$= \frac{\begin{bmatrix} 2 & 2 \\ -3 & 2 \end{bmatrix}}{10}$$

$$= \frac{1}{10}\begin{bmatrix} 2 & 2 \\ -3 & 2 \end{bmatrix}$$

$$X = A^{-1} B$$

$$= \frac{1}{10}\begin{bmatrix} 2 & 2 \\ -3 & 2 \end{bmatrix}\begin{bmatrix} 4 \\ 6 \end{bmatrix}$$

$$= \frac{1}{10}\begin{bmatrix}(2\times 4)+(2\times 6)\\(-3\times 4)+(2\times 6)\end{bmatrix}$$

$$= \frac{1}{10}\begin{bmatrix}8+12\\-12+12\end{bmatrix}$$

$$= \frac{1}{10}\begin{bmatrix}20\\0\end{bmatrix}$$

$$= \begin{bmatrix}\frac{20}{10}\\\frac{0}{10}\end{bmatrix}$$

$$\begin{bmatrix}x\\y\end{bmatrix} = \begin{bmatrix}2\\0\end{bmatrix}$$

$\Rightarrow$ $x = 2$ and $y = 0$

S.S = (2, 0)

(b) Find x and y: $(2 - 3i)(x + yi) = 2(x - 2yi) + 2i - 1$. (4)

Ans $(2 - 3i)(x + yi) = 2(x - 2yi) + 2i - 1$

$2(x + yi) - 3i(x + yi) = 2x - 4yi + 2i - 1$

$2x + 2yi - 3xi - 3yi^2 = 2x - 1 - (4y - 2)i$

$(2x + 3y) - (3x - 2y)i = (2x - 1) - (4y - 2)i$

Equating the real part,

$2x + 3y = 2x - 1$

$3y = 2x - 1 - 2x$

$3y = -1$

$y = \frac{-1}{3}$ (i)

Equating the Imag. part,

$-(3x - 2y) = -(4y - 2)$

$3x - 2y = 4y - 2$

$3x = 4y + 2y - 2$

$3x = 6y - 2$

From (i), $y = \frac{-1}{3}$

$3x = 6\left(-\frac{1}{3}\right) - 2$

$3x = -2 - 2$

$3x = -4$

$$x = \frac{-4}{3}$$

$$\therefore \quad x = \frac{-4}{3}, \; y = \frac{-1}{3}$$

$$S.S = \left(\frac{-4}{3}, \frac{-1}{3}\right)$$

Q.6.(a) Use log tables to find the value of: **(4)**

$$\frac{(1.23)(0.6975)}{(0.0075)(1278)}$$

Ans For Answer see Paper 2016 (Group-I), Q.6.(a).

(b) **If $q = \sqrt{5} + 2$, then find the value of $q - \frac{1}{q}$ and $q^2 + \frac{1}{q^2}$.** **(4)**

Ans Given

$$q = \sqrt{5} + 2 \qquad \text{(i)}$$

$$\frac{1}{q} = \frac{1}{\sqrt{5} + 2} \qquad \text{(ii)}$$

$$= \frac{1}{\sqrt{5} + 2} \times \frac{\sqrt{5} - 2}{\sqrt{5} - 2}$$

$$= \frac{\sqrt{5} - 2}{(\sqrt{5})^2 - (2)^2}$$

$$= \frac{\sqrt{5} - 2}{5 - 4}$$

$$= \frac{\sqrt{5} - 2}{1}$$

$$\boxed{\frac{1}{q} = \sqrt{5} - 2}$$

Subtract eq. (i) and (ii)

$$q - \frac{1}{q} = (\sqrt{5} + 2) - (\sqrt{5} - 2)$$

$$= \sqrt{5} + 2 - \sqrt{5} + 2$$

$$\boxed{q - \frac{1}{q} = 4}$$

By taking square of both sides,

$$\left(q - \frac{1}{q}\right)^2 = (4)$$

$$q^2 + \frac{1}{q^2} - 2(q)\left(\frac{1}{q}\right) = 16$$

$$q^2 + \frac{1}{q^2} - 2 = 16$$

$$q^2 + \frac{1}{q^2} = 16 + 2$$

$$\boxed{q^2 + \frac{1}{q^2} = 18}$$

Q.7.(a) Factorize: $4x^2 - 17xy = 4y^2$ (4)

Ans

$$= 4x^2 - 17xy + 4y^2$$

Making pair,

$$= 4x^2 - 16xy - xy + 4y^2$$
$$= 4x(x - 4y) - y(x - 4y)$$
$$= (x - 4y)(4x - y)$$

(b) Simplify: $\dfrac{x^2 - x - 6}{x^2 - 9} + \dfrac{x^2 + 2x - 24}{x^2 - x - 12}$ (4)

Ans

$$\frac{x^2 - x - 6}{x^2 - 9} + \frac{x^2 + 2x - 24}{x^2 - x - 12}$$

$$= \frac{x^2 - 3x + 2x - 6}{(x + 3)(x - 3)} + \frac{x^2 + 6x - 4x - 24}{x^2 - x - 12}$$

$$= \frac{x(x - 3) + 2(x - 3)}{(x + 3)(x - 3)} + \frac{x(x + 6) - 4(x + 6)}{x^2 - 4x + 3x - 12}$$

$$= \frac{(x - 3)(x + 2)}{(x + 3)(x - 3)} + \frac{(x + 6)(x - 4)}{x(x - 4) + 3(x - 4)}$$

$$= \frac{(x - 3)(x + 2)}{(x + 3)(x - 3)} + \frac{(x + 6)(x - 4)}{(x + 3)(x - 4)}$$

$$= \frac{x + 2}{x + 3} + \frac{x + 6}{x + 3}$$

$$= \frac{(x+2)+(x+6)}{(x+3)}$$

$$= \frac{x+2+x+6}{x+3}$$

$$= \frac{2x+8}{x+3}$$

$$= 2\,\frac{(x+4)}{x+3}$$

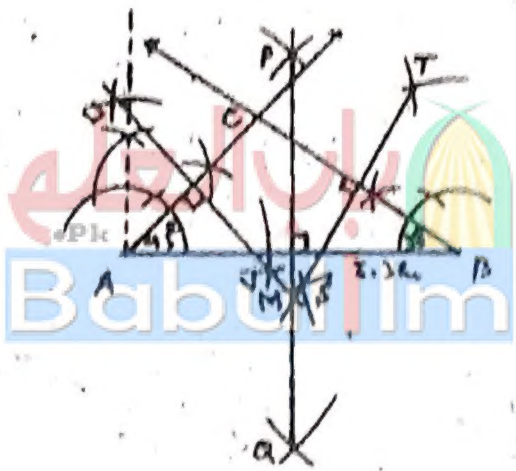
Q.8.(a) Solve: $\dfrac{2}{3x+6} = \dfrac{1}{6} - \dfrac{1}{2x+4}$, $x \neq -2$ **(4)**

Ans For Answer see Paper 2016 (Group-I), Q.8.(a).

(b) Construct the ΔABC. Draw the perpendicular bisectors of its sides: **(4)**

$m\overline{AB} = 5.3$ cm, $m\angle A = 45^\circ$, $m\angle B = 30^\circ$

Ans



Given:

$m\overline{AB} = 5.3$ cm

$m\angle A = 45^\circ$

$m\angle B = 30^\circ$

Required:

Construct ΔABC. Draw perpendicular bisector of its sides and verify their concurrency.

Steps of Construction:

(i) Take a line segment $\overline{AB} = 5.3$ cm.

(ii) Make an angle $\angle BAW = 45^\circ$.

(iii) Make an angle $\angle ABJ = 30^{o}$.

$\overline{AW}$, $\overline{BJ}$ intersect at point C.
ABC is the required triangle.

(iv) Take $\overline{PQ}$, $\overline{TS}$, $\overline{UV}$ right bisectors of $\overline{AB}$, $\overline{BC}$, $\overline{CA}$, respectively.

Q.9. Any point on the right bisector of a line segment is equidistant from its end points. (8)

Ans For Answer see Paper 2021 (Group-I), Q.9.

OR

Any point on the bisector of an angle is equidistant from its arms.

Ans For Answer see Paper 2016 (Group-I), Q.9.